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November 24, 2004
Project No 36-064

Mr. Albert Liu
Barry Swenson Builder
777 North First Street
5th Floor
San Jose, CA 95126

Subject: Noise Assessment Study for the Planned Townhouse Development,
Toyama Drive and Morse Avenue, Sunnyvale

Dear Mr. Liu:

This report presents the results of a noise assessment study for the planned townhouse development at Toyama Drive and Morse Avenue in Sunnyvale, as shown on the Site Plan, Ref. (a). The noise exposures at the site were evaluated against the standards of the City of Sunnyvale Noise Sub-Element, Ref. (b), and the State of California Code of Regulations, Title 24, Ref. (c), which applies to all new multi-family housing. The analysis of the on-site sound level measurements indicates that the existing noise environment at the site is due to a combination of sources including Highway 101, Morse Avenue and Toyama Drive traffic, and operations at the Excelfab company facility. The noise exposures measured at the site from intermittent activity at the adjacent Compact Media, activity at the shop area of the Excelfab company, traffic sources on Highway 101, Morse Avenue and Toyama Drive do not significantly impact the site. The results of the study indicate that the noise exposures are within the limits of the standards of the City of Sunnyvale Noise Sub-Element and the Title 24 criterion. Mitigation measures will not be required. Title 24 does not require an acoustical analysis for this project.

Section I of this report contains a summary of our findings. Subsequent sections contain the site, traffic, and project descriptions, analyses, and evaluations. Attached hereto are Appendices A, B, and C, which include the list of references, descriptions of the applicable standards, definitions of the terminology, descriptions of the acoustical instrumentation used for the field survey, and the on-site noise measurement data and calculation tables.

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I. Summary of Findings

The noise assessment results presented in the findings were evaluated against the standards of the City of Sunnyvale Noise Sub-Element, which utilizes the Day-Night Level (DNL) descriptor. Policy 3.6A.1f states, "Supplement the 'Noise and Land Use Compatibility Guidelines' for residential uses by attempting to achieve an outdoor L_{dn} (DNL) of no greater than 60 dBA for common recreation areas, backyards, patios, and medium and large balconies."

The Title 24 standards also use the DNL descriptor and specify that when the exterior noise exposures exceed 60 dB DNL at planned multi-family dwelling units an acoustical analysis must be performed to limit interior noise exposures to 45 dB DNL or less.

The Title 24 standards also specify minimum sound insulation ratings for common partitions separating different dwelling units and dwelling units from interior common spaces. The standards specify that common walls and floor/ceiling assemblies must have a design Sound Transmission Class (STC) rating of 50 or higher. In addition, common floor/ceiling assemblies must have a design Impact Insulation Class (IIC) rating of 50 or higher. As design details for the interior partitions of the project were not available at the time of this study, an evaluation of the interior partitions has not been made.

The noise levels shown below are without the application of mitigation measures and represent the noise environment for existing site conditions.

A. Exterior Noise Exposures

- The existing exterior noise exposure in the most impacted porches and planned building setback from Morse Avenue (40 ft. from the centerline) is 60 dB DNL. Under future traffic conditions, the noise exposure is expected to remain at 60 dB DNL. Thus, the noise exposures will be within the 60 dB DNL limit of the City of Sunnyvale Noise Sub-Element standards and the Title 24 criterion.

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The primary sources of noise in the site vicinity include Morse Avenue traffic, Toyama Drive traffic, activity at Compact Media Group and Excelfab. Morse Avenue carries an existing Average Daily Traffic (ADT) volume of 3,880 vehicles, as reported by the City of Sunnyvale, Ref. (d).

Excelfab is a precision sheetmetal business that operates from 6:00 a.m. to 5:00 p.m. daily, as reported by the Excelfab company, Ref. (e). The interior of the shop area is visible from the project site as the shop is accessible through roll-up doors at the rear of the building.

The Compact Media Group could not be reached for comment.

The planned project includes the construction of ⁵⁰ ~~80~~ townhouse units in fourteen 3-story buildings. Ingress and egress to the project will be by way of driveways off of Morse Avenue and Toyama Drive.

III. Analysis of the Noise Levels

A. Existing Noise Levels

To determine the existing noise environment at the site, continuous recordings of the sound levels were made at three locations. Location 1 was 25 ft. from the centerline of the Toyama Drive. Location 2 was 27 ft. from the centerline of Morse Avenue. Location 3 was near the side property line closest to the rear of the Excelfab building with a line-of-sight into the shop. These locations represent the most noise impacted areas of the site. The measurements were made on November 15-16, 2004 for continuous periods of 24 hours at Locations 1 and 2 and for 1 hour at Location 3. The noise levels were acquired during representative hours during the daytime and nighttime periods of the DNL index.

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The noise level data were recorded and processed using Larson-Davis Model 812 Precision Integrating Sound Level Meters. The meters yield, by direct readout, a series of descriptors of the sound levels versus time which are commonly used to describe community noise, as described in Appendix B. The measured descriptors include the L_1 , L_{10} , L_{50} , and L_{90} , i.e., those levels exceeded 1%, 10%, 50% and 90% of the time. Also measured were the maximum and minimum levels and the continuous equivalent-energy levels (L_{eq}), which are used to calculate the DNL's. The results of the measurements are shown in the data table in Appendix C.

The results of the field survey reveal that the L_{eq} 's at Location 1, 25 ft. from the centerline of Toyama Drive, ranged from 53.5 to 62.2 dBA during the daytime and from 47.1 to 55.0 dBA at night. These noise levels included noise from Toyama Drive traffic and activity at Compact Media Group.

The L_{eq} 's at Location 2, 27 ft. from the centerline of Morse Avenue, ranged from 57.1 to 68.0 dBA during the daytime and from 49.4 to 57.8 dBA at night. These noise levels included noise from Morse Avenue and Highway 101 traffic.

The L_{eq} at the side property line of the site closest to the Excelfab shop is 58 dBA. As the shop operates fairly constantly throughout the day, the hourly average noise levels should be consistent for the operational day of 6:00 a.m. to 5:00 p.m.

Traffic noise dissipates at the rate of 3 to 6 dB for each doubling of the distance from the source (centerline of the roadway). Stationary/single source noise diminish at a rate of 6 dB per doubling of the distance from the source to the receiver. Thus, locations on the site at greater distances from Toyama Drive, Morse Avenue, Compact Media Group or Excelfab will have lower noise levels. Additional acoustical shielding will be provided by interposed buildings of the project.

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B. Future Noise Levels

Precise future traffic volume information for Toyama Drive and Morse Avenue was not available from the City of Sunnyvale. For the purposes of this study, we are assuming that the future traffic and commercial/industrial operations in the site vicinity will remain similar to present levels.

IV. Evaluations of the Noise Exposures**A. Exterior Noise Exposures**

To evaluate the on-site noise exposures against the City of Sunnyvale standards and the Title 24 criterion, the DNL's for the survey locations were calculated by decibel averaging of the L_{eq} 's as they apply to the daily time periods of the DNL index. The DNL is a 24-hour noise descriptor that uses the measured L_{eq} values to calculate a 24-hour time-weighted average noise exposure. The formula used to calculate the DNL is described in Appendix B.

The results of the calculations yield a noise exposure of 60 dB DNL at measurement Location 1, 25 ft. from the centerline of Toyama Drive. A noise exposure of 63 dB DNL was calculated for measurement Location 2, 27 ft. from the centerline of Morse Avenue. A noise exposure of 54 dB DNL was calculated for measurement Location 3 at the side property line closest to the Excelfab shop.

A 4 dB reduction was applied to the Toyama Drive traffic noise levels and a 3 dB reduction was applied to the Morse Avenue traffic noise levels to account for the increased setback distance of planned buildings and porches from the measurement locations using methods established by the Highway Research Board, Ref. (f).

The noise exposure at the planned minimum setback of units along Toyama Drive was calculated to be 56 dB DNL. Under future conditions, the noise exposures are expected to remain similar to present levels. Thus, the noise exposures will be within the limits of the City of Sunnyvale Noise Element standards and the Title 24 criterion.

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The noise exposure at the planned minimum setback of units along Morse Avenue was calculated to be 60 dB DNL. Under future conditions, the noise exposures are expected to remain similar to present levels. Thus, the noise exposures will be within the limits of the City of Sunnyvale Noise Element standards and the Title 24 criterion.

The noise exposure at the planned minimum setback of units closest to the Excelfab shop was calculated to be 54 dB DNL. Under future conditions, the noise exposures are expected to remain similar to present levels. Thus, the noise exposures will be within the limits of the City of Sunnyvale Noise Sub-Element standards and the Title 24 criterion.

B. Interior Noise Exposures

To evaluate the interior noise exposures in project living spaces, a 15 dB reduction was applied to the exterior noise exposure to represent the attenuation provided by the building shell under *annual-average* conditions. The *annual-average* condition assumes that windows have single-strength (3/32") glass and are kept open up to 50 % of the time for natural ventilation.

The interior noise exposures in living spaces closest to Toyama Drive will be 41 dB DNL under existing and future conditions. Thus, the noise exposures will be within the limits of the City of Sunnyvale Noise Sub-Element and Title 24 standards.

The interior noise exposures in living spaces closest to Morse Avenue will be 45 dB DNL under existing and future conditions. Thus, the noise exposures will be within the limits of the City of Sunnyvale Noise Sub-Element and Title 24 standards.

The interior noise exposures in living spaces closest to the Excelfab shop will be 39 dB DNL under existing and future conditions. Thus, the noise exposures will be within the limits of the City of Sunnyvale Noise Sub-Element and Title 24 standards.

As shown by the above evaluations, the exterior and interior noise exposures will be within the limits of the standards of the City of Sunnyvale Noise Sub-Element and Title 24. Mitigation measures will not be required.

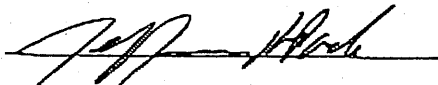
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This report presents the results of a noise assessment study for the planned townhouse development along Morse Avenue and Toyama Drive in Sunnyvale. The study findings for present conditions are based on field measurements and other data and are correct to the best of our knowledge. Significant changes in the traffic volumes, Compact Media Group or Excelfab operations, or changes in other nearby commercial/industrial uses, speed limits, motor vehicle technology, noise regulations, or other changes beyond our control may produce long-range noise results different from our estimates.

If you have any questions or would like an elaboration of this report, please call me.

Sincerely,

EDWARD L. PACK ASSOC., INC.



Jeffrey K. Pack
President

Attachments: Appendices A, B, and C

APPENDIX A

References

- (a) Site Plan, Toyama Townhouses, by Barry Swenson Builder, September 28, 2004
- (b) Noise Sub-Sub-Element of the General Plan, City of Sunnyvale, March 25, 1997
- (c) California Code of Regulations, Title 24, Part II, "Sound Transmission Control", Revised 1989
- (d) Information on Existing and Future Traffic Volumes Provided by Mr. Jack Witthaus, City of Sunnyvale Transportation Planning Department, by Telepne to Edward L. Pack Associates, Inc., December 11, 2002
- (e) Information on Excelfab Operations Provided by Ms. Sandra Harlan, Excelfab, Inc., by Telephone to Edward L. Pack Associates, Inc., November 24, 2004
- (f) Highway Research Board, "Highway Noise - A Design Guide for Highway Engineers", Report 117, 1971

APPENDIX B

Noise Standards, Terminology, Instrumentation

1. Noise Standards

A. City of Sunnyvale Noise Sub-Element Standards

The noise criteria for residential uses in the City of Sunnyvale are specified in the Noise Sub Sub-Element of the General Plan, as approved by the City Council, March 25, 1997. These standards include the following:

- Attempt to achieve an outdoor limit of 60 dB DNL for common recreation areas, backyards, patios, and useable balconies. This standard does not apply where the noise source is a railroad or airport.
- Enforce the California Code of Regulations, Title 24 noise standard of 45 dB DNL multi-family for interiors. This standard shall also be applied to single-family interiors.
- When the noise source is a railroad, 70 dB DNL is acceptable for exteriors. Attempt to achieve maximum instantaneous noise levels (L_{max}) of 50 dBA for bedrooms and 55 dBA for other living spaces when the noise source is a railroad or aircraft and the exterior DNL exceeds 55 dB.

B. Title 24 Noise Standards

The California Code of Regulations, "Sound Transmission Control", Title 24, Part II, applies to all new multi-family dwellings including condominiums, townhouses, apartments, hotels and motels. The standards, which utilize the Day-Night Level (DNL) descriptor, establish an exterior reference or criterion level of 60 dB DNL, and specify that multi-family buildings to be located within an annual DNL zone of 60 dB or greater require an acoustical analysis. The analysis report must show that the planned buildings provide adequate attenuation to limit intruding noise from exterior sources to an annual DNL of 45 dB or less in any habitable space. The Community Noise Equivalent Level (CNEL) descriptor, which is similar to the DNL, may also be used, as the DNL and CNEL are considered to be equivalent.

The Title 24 standards also establish minimum sound insulation requirements for interior partitions separating different dwelling units from each other and dwelling units from common spaces such as garages, corridors, equipment rooms, etc. The common interior walls and floor/ceiling assemblies must achieve a minimum Sound Transmission Class (STC) rating of 50 for airborne noise. Common floor/ceiling assemblies must achieve an Impact Insulation Class (IIC) rating of 50 for impact noise. These ratings are based on laboratory tested partitions. Field tested partitions must achieve ratings of NIC and FIIC 45.

2. Terminology

A. Statistical Noise Levels

Due to the fluctuating character of urban traffic noise, statistical procedures are needed to provide an adequate description of the environment. A series of statistical descriptors have been developed which represent the noise levels exceeded a given percentage of the time. These descriptors are obtained by direct readout of the Community Noise Analyzer. Some of the statistical levels used to describe community noise are defined as follows:

L_1	-	A noise level exceeded for 1% of the time.
L_{10}	-	A noise level exceeded for 10% of the time, considered to be an "intrusive" level.
L_{50}	-	The noise level exceeded 50% of the time representing an "average" sound level.
L_{90}	-	The noise level exceeded 90 % of the time, designated as a "background" noise level.
L_{eq}	-	The continuous equivalent-energy level is that level of a steady-state noise having the same sound energy as a given time-varying noise. The L_{eq} represents the decibel level of the time-averaged value of sound energy or sound pressure squared and is used to calculate the DNL and CNEL.

B. Day-Night Level (DNL)

Noise levels utilized in the standards are described in terms of the Day-Night Level (DNL). The DNL rating is determined by the cumulative noise exposures occurring over a 24-hour day in terms of A-Weighted sound energy. The 24-hour day is divided into two subperiods for the DNL index, i.e., the daytime period from 7:00 a.m. to 10:00 p.m., and the nighttime period from 10:00 p.m. to 7:00 a.m. A 10 dB weighting factor is applied (added) to the noise levels occurring during the nighttime period to account for the greater sensitivity of people to noise during these hours. The DNL is calculated from the measured L_{eq} in accordance with the following mathematical formula:

$$DNL = [(L_d + 10 \log_{10} 15) \& (L_n + 10 + 10 \log_{10} 9)] - 10 \log_{10} 24$$

Where:

- L_d = L_{eq} for the daytime (7:00 a.m. to 10:00 p.m.)
- L_n = L_{eq} for the nighttime (10:00 p.m. to 7:00 a.m.)
- 24 - indicates the 24-hour period
- & - denotes decibel addition.

C. A-Weighted Sound Level

The decibel measure of the sound level utilizing the "A" weighted network of a sound level meter is referred to as "dBA". The "A" weighting is the accepted standard weighting system used when noise is measured and recorded for the purpose of determining total noise levels and conducting statistical analyses of the environment so that the output correlates well with the response of the human ear.

3. Instrumentation

The on-site field measurement data were acquired by the use of one or more of the precision acoustical instruments shown below. The acoustical instrumentation provides a direct readout of the L exceedance statistical levels including the equivalent-energy level (L_{eq}). Input to the meters was provided by a microphone extended to a height of 5 ft. above the ground. The meter conforms to ANSI S1.4 for Type 1 instruments. The "A" weighting network and the "Fast" response setting of the meter were used in conformance with the applicable ISO and IEC standards. All instrumentation was acoustically calibrated before and after field tests to assure accuracy.

Bruel & Kjaer 2231 Precision Integrating Sound Level Meter

Larson Davis LDL 812 Precision Integrating Sound Level Meter

Larson Davis 2900 Real Time Analyzer

APPENDIX C

Noise Measurement Data and Calculation Tables

DNL CALCULATIONS									
CLIENT:	BARRY SWENSON BUILDER								
FILE:	36-064								
PROJECT:	TOYAMA TOWNHOUSES								
DATE:	11/15-16/2004								
SOURCE:	TOYAMA DR., MORSE AVE.,								
LOCATION 1	Toyama Dr.								
Dist. to Source	25 ft.								
TIME	Leq	10 ¹ Leq/10							
7:00a.m.	58.6	724436.0							
8:00 a.m.	60.5	1122018.5							
9:00a.m.	58.6	724436.0							
10:00a.m.	60.7	1174897.6							
11:00 a.m.	62.2	1659566.9							
12:00noon	61.2	1318256.7							
1:00p.m.	58.7	741310.2							
2:00 p.m.	58.4	691831.0	63.4						
3:00 p.m.	58.6	724436.0	59.9						
4:00 p.m.	58.4	691831.0							
5:00 p.m.	57.1	512861.4							
6:00 p.m.	54.3	269153.5							
7:00 p.m.	53.6	229086.8							
8:00 p.m.	54.3	269153.5							
9:00 p.m.	53.5	223872.1	SUM=	11077166.9					
10:00 p.m.	54.9	309029.5	Ld=	58.7					
11:00 p.m.	53.6	229086.8							
12:00midn	51.9	154881.7							
1:00 a.m.	51.9	154881.7							
2:00 a.m.	50.6	114815.4							
3:00 a.m.	50.8	120226.4							
4:00 a.m.	51.4	138038.4							
5:00 a.m.	47.1	51286.1							
6:00 a.m.	55.0	316227.8	SUM=	1588473.8					
			Ln=	52.5					
Daytime Level=	70.5								
Nighttime Level=	72.0								
DNL=	60								
24-Hour Leq=	67.2								